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Radiographic Perioperative Evaluation of Pancreatic Transplant

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Patient Presentation

- 41 y.o. female with Type I diabetes mellitus for 24 years
 - Difficulty controlling glucose levels
 - Frequent and severe episodes of metabolic complications (i.e. DKA)
 - Peripheral neuropathy
 - Chronic renal failure (diabetic nephropathy) requiring dialysis



Treatment Options

- Optimize insulin control
 - Alter type of insulin regimen used
 - Insulin pump for improved insulin dose control
- Treat/prevent secondary complications
 - Nephropathy: Strict BP control (ACEI); dialysis
 - Retinopathy: Photocoagulation
 - Neuropathy: Pain management
- PANCREAS TRANSPLANT



Selection Criteria at BIDMC

- Anyone with uncontrolled or poorly controlled Type I diabetes and at least one of the following:
 - HbA1C persistently $>7\%$
 - Proliferative retinopathy
 - Diabetic Nephropathy diagnosed by biopsy or proteinuria
 - Autonomic or peripheral neuropathy
 - Frequent and severe metabolic crises resulting in hospitalization



BIDMC Contraindications

- Age must be between 13 and 65
- BMI > 35
- Type 2 diabetes mellitus
- CV disease
 - Recent MI
 - Significant CAD
 - CHF
 - Severe peripheral vascular disease with ischemia of at least one limb
- Cancer diagnosis within 5 years
- Possible difficulty with compliance to rigorous post operative medication regime



How common is this procedure?

- The first clinical pancreas transplant was done with a simultaneous kidney transplant at the University of Minnesota on 12/16/66.
- Total of 14,000 pancreas worldwide
- Current annual average around 1000



Surgical Transplant Options

- Simultaneous Pancreas Kidney (SPK)
- Sequential Pancreas after Kidney (PAK)
- Living Donor Kidney Transplant Alone (LDKTA) + PAK
- Pancreas Transplantation Alone (PTA)

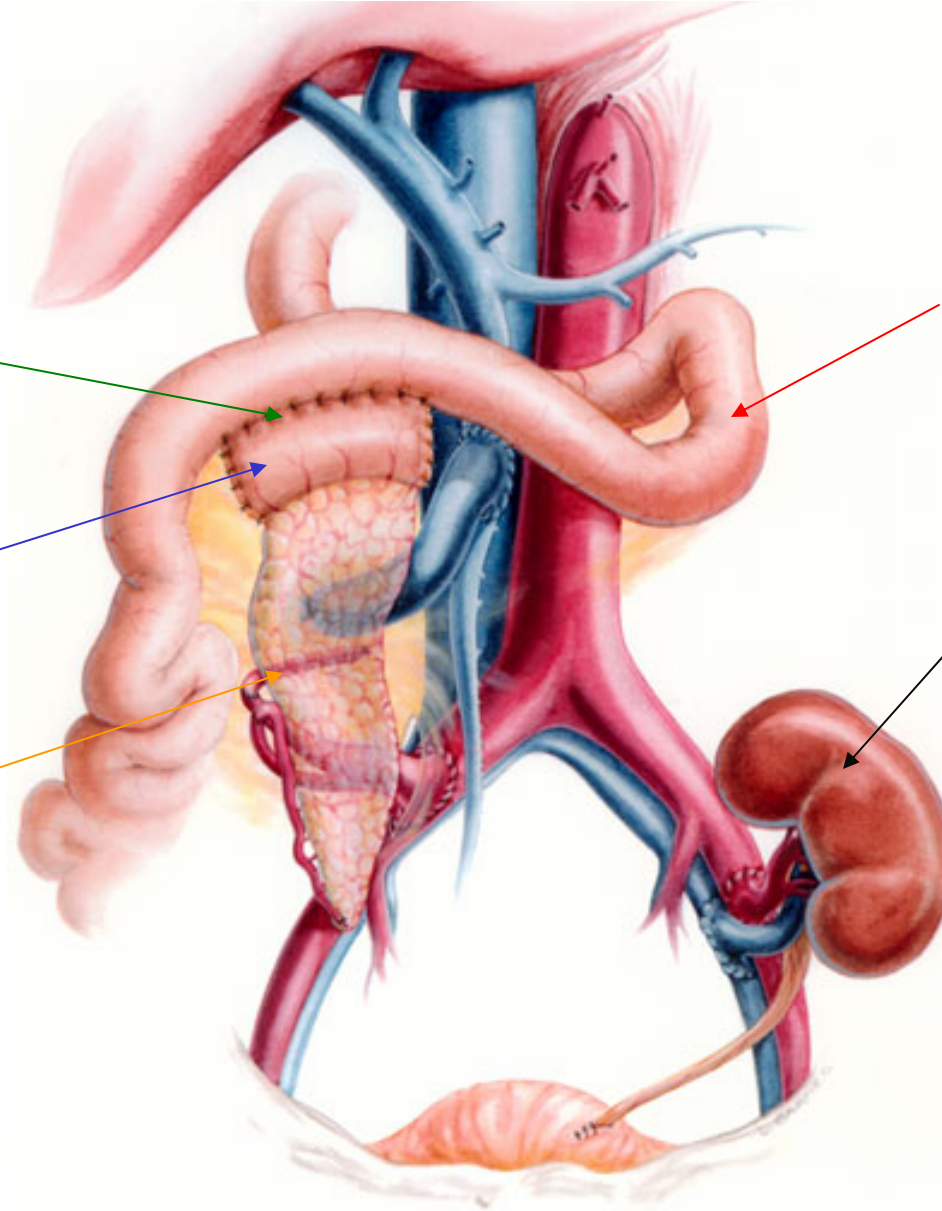


Transplant procedure: Exocrine Drainage Methods

- Cutaneous graft duodenostomy
 - Metabolic acidosis (loss of bicarbonate)
- Open duct free intraperitoneal drainage
 - Severe peritonitis & amylase ascites
- Polymer duct injection and occlusion
 - Severe pancreatitis
- Enterovesical drainage
 - Chronic cystitis, reflux pancreatitis, recurrent UTI, metabolic acidosis, urethritis
- **Enteric drainage: Side-to-side duodenoenterostomy currently preferred**



Side-to-side Duodenoenterostomy



Enteric anastomosis

**Recipient jejunum
or ileum**

Donor Duodenal Stump

Donor Kidney

Donor Pancreas

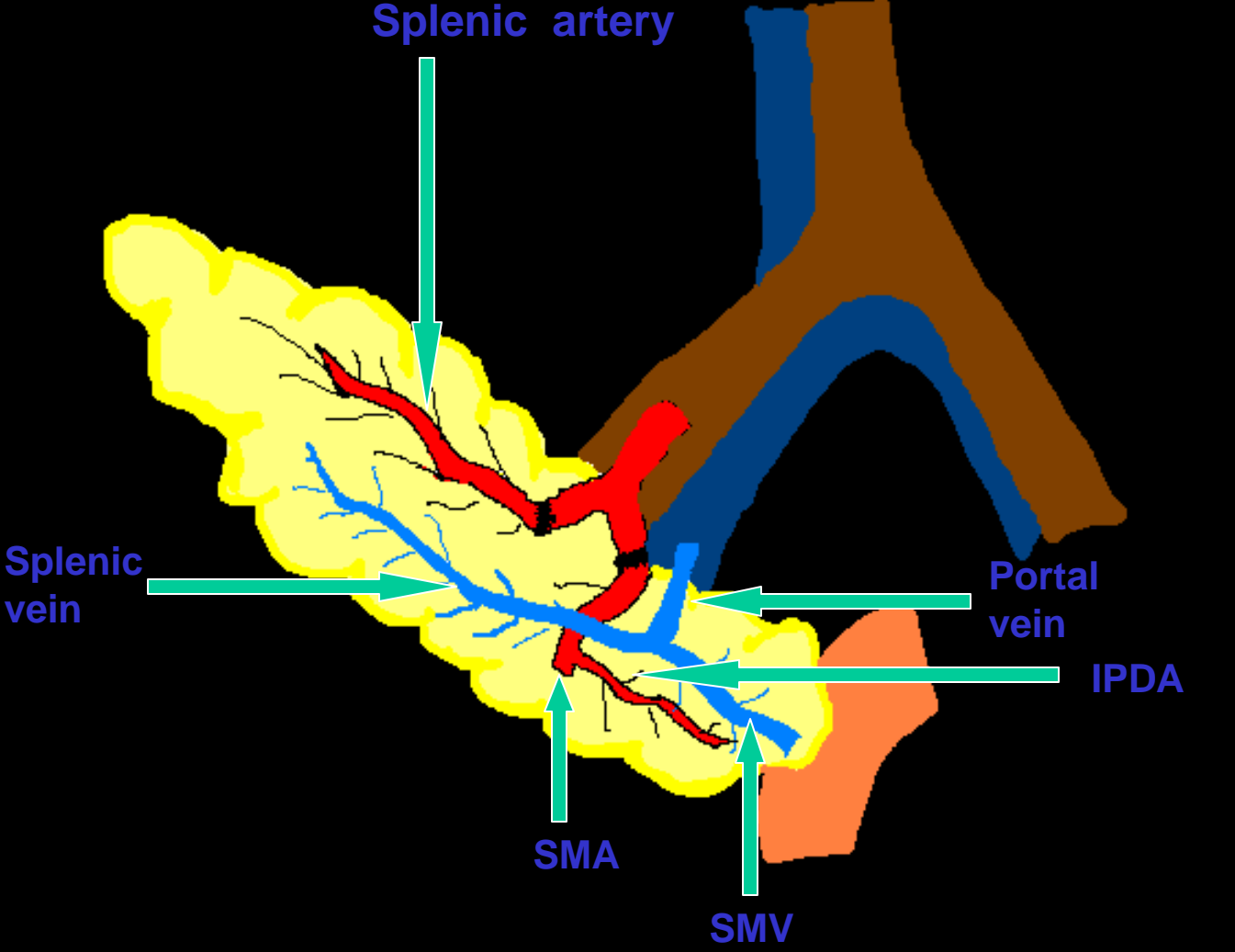


Vascular Anastamoses

- Arterial anastamosis: RLQ using donor splenic artery and SMA to recipient common iliac via Y-graft
- Venous anastamosis
 - Portal:
 - Donor portal vein to recipient superior mesenteric vein
 - Physiologic, but technically very challenging
 - Systemic:
 - Donor portal vein to recipient common iliac vein
 - Technically less challenging
 - Possible complications: Hyperinsulinemia resulting in dyslipidemia, accelerated atherosclerosis, and insulin resistance
 - Retrospective study indicating graft survival higher in portal (79%) vs systemic (65%) anastomosis



Vascular Anatomy





Causes for Graft Loss

- **Technical Failure: 9%**
 - Vascular thrombosis (Most common complication)
 - Anastomotic leak
 - Infection
 - Pancreatitis
 - Bleeding
- **Allograft Rejection: 3-16% at 1 yr**



HOW CAN WE IDENTIFY
THESE PROBLEMS?

RADIOLOGY



Imaging technique: Ultrasound

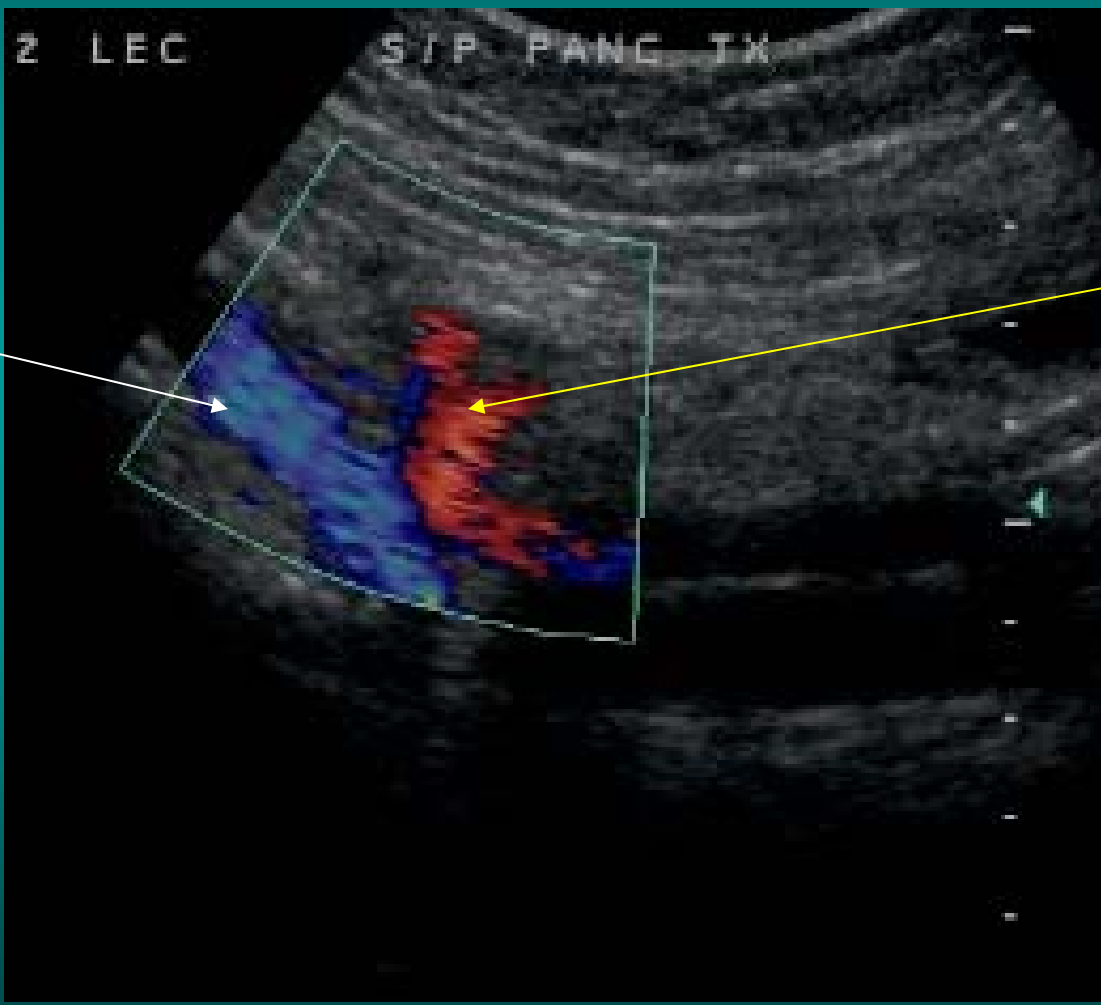
- Advantages
 - Very good at assessing vasculature using spectral and color flow doppler
 - No radiation
 - Can identify peri-pancreatic fluid collections
- Limitations
 - Pancreas does not have discrete capsule resulting in difficulty visualizing pancreas among bowel loops
 - Etiology for fluid collections cannot be delineated



Patent Pancreatic Transplant Vessels by Color Flow Doppler

Venous Flow

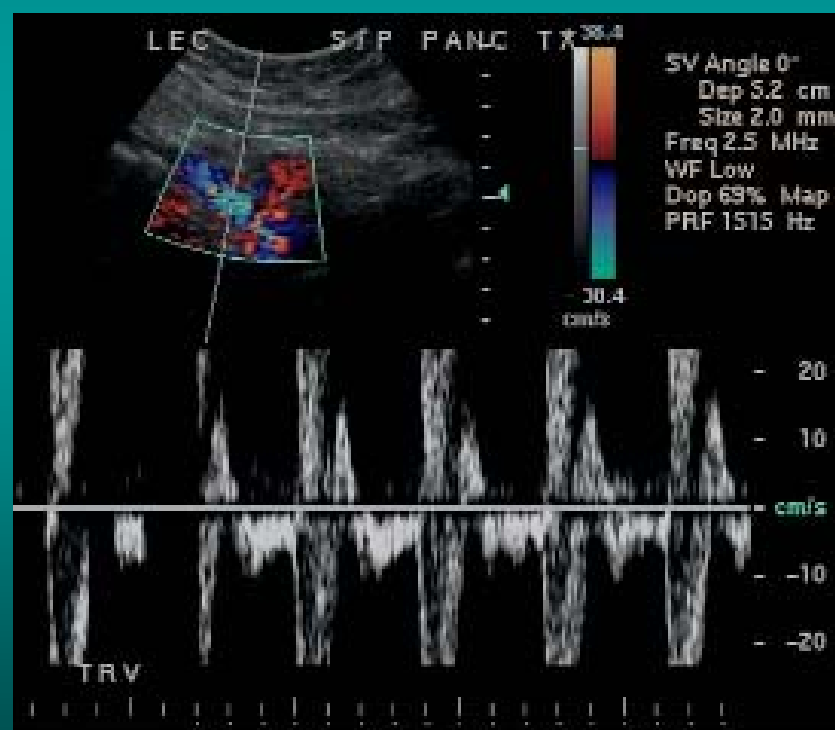
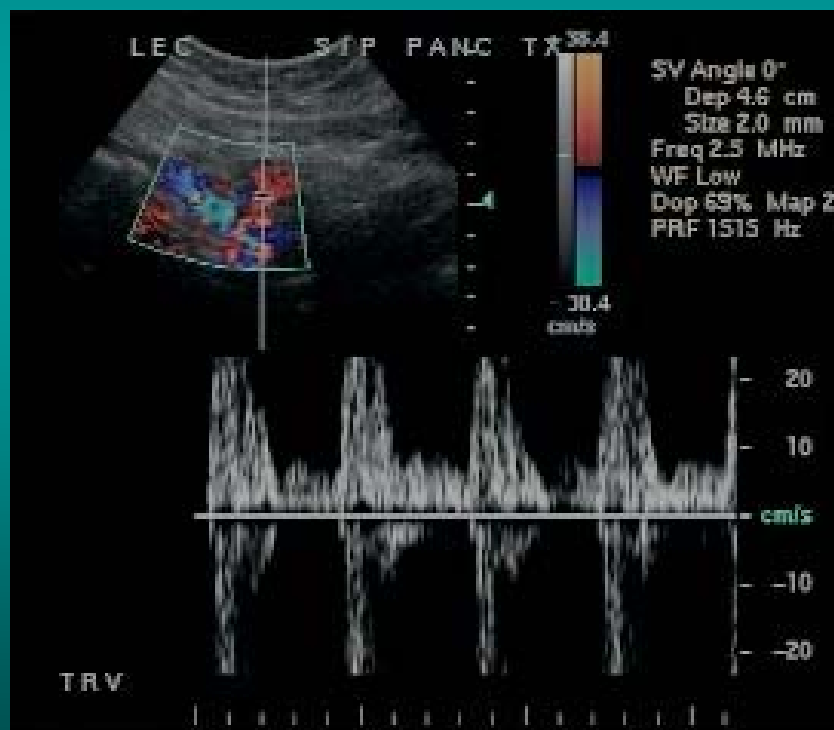
Arterial Flow





Patent Pancreatic Transplant Vessels by Spectral and Color Flow Doppler

Good Arterial and Venous Wave Pattern





US Vascular Evaluation #1

Patient with lower abdominal pain and rising glucose levels



Proximal vessel
entering pancreas



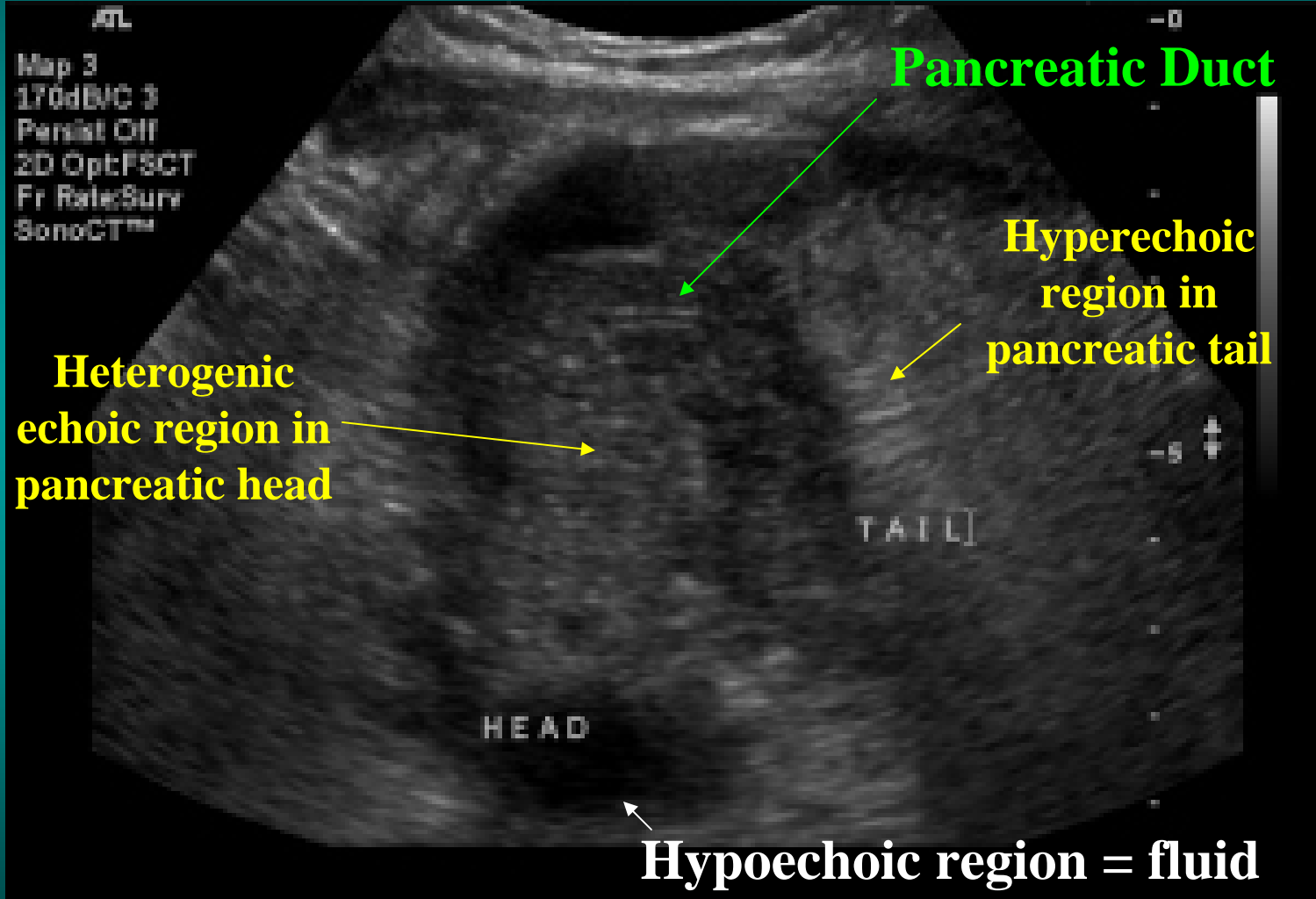
Lack of vascular flow in
pancreas by color doppler

Diagnosis: Arterial Thrombosis
Resulted in allograft pancreatectomy



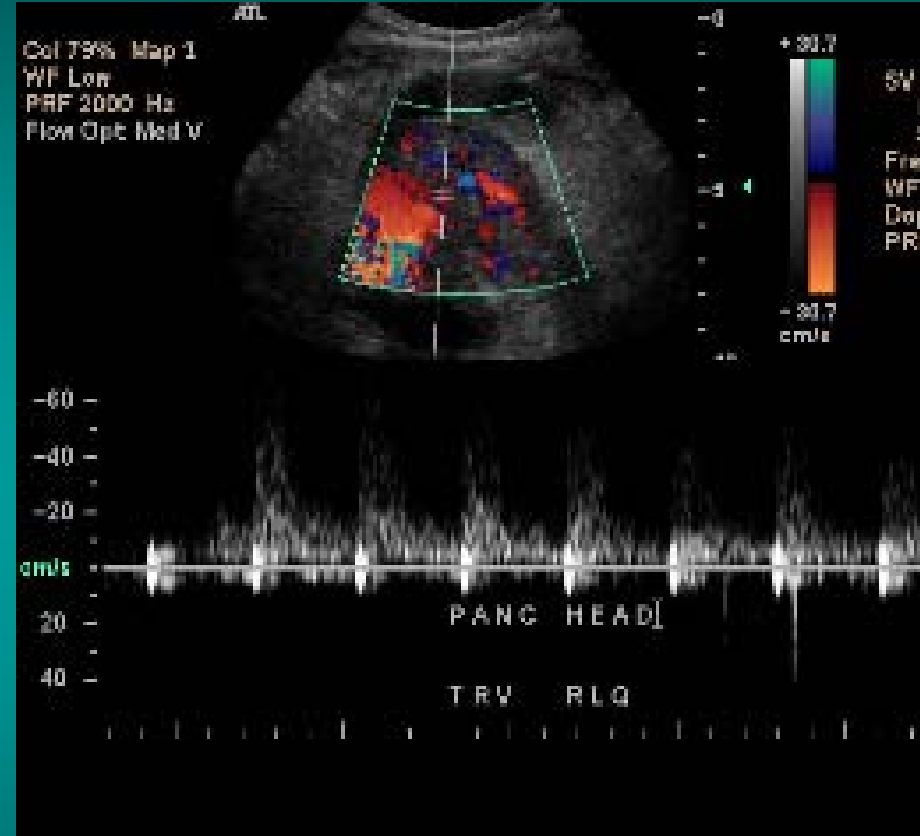
US Vascular Evaluation #2

Patient with rising glucose levels





US Vascular Evaluation #2



Spectral flow analysis showed decreased arterial flow to pancreatic head

**Diagnosis: Pancreatic Head Thrombosis
Resulted in pancreatic head resection**



Imaging Technique: CT

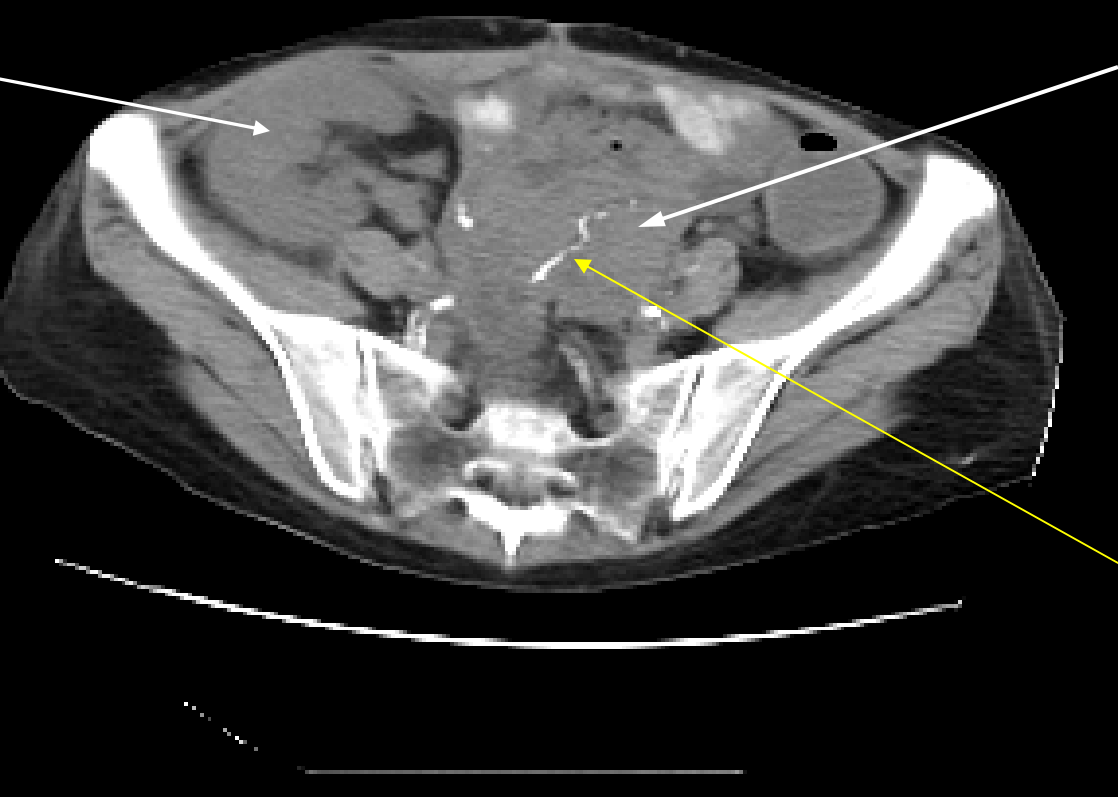
- **Advantages**
 - Effective enteric anastomotic leak detection via oral contrast extravasation
 - Detection and evaluation of fluid collections
 - Hematoma, ascites, pseudocysts, abscess, or urinoma
 - Evaluate complications of pancreatitis
 - Abscess, pseudocyst, adjacent tissue involvement
 - Vascular compromise evaluation can be done with contrast
 - CT guided drainage of pseudocysts, abscess, fluid
- **Disadvantages**
 - Severe renal failure precludes IV contrast
 - Often difficult to differentiate fluid collections and changes of pancreas morphology
 - Largest radiation dose



Where is that pancreas?

**Kidney
Transplant**

**Pancreas
Transplant**



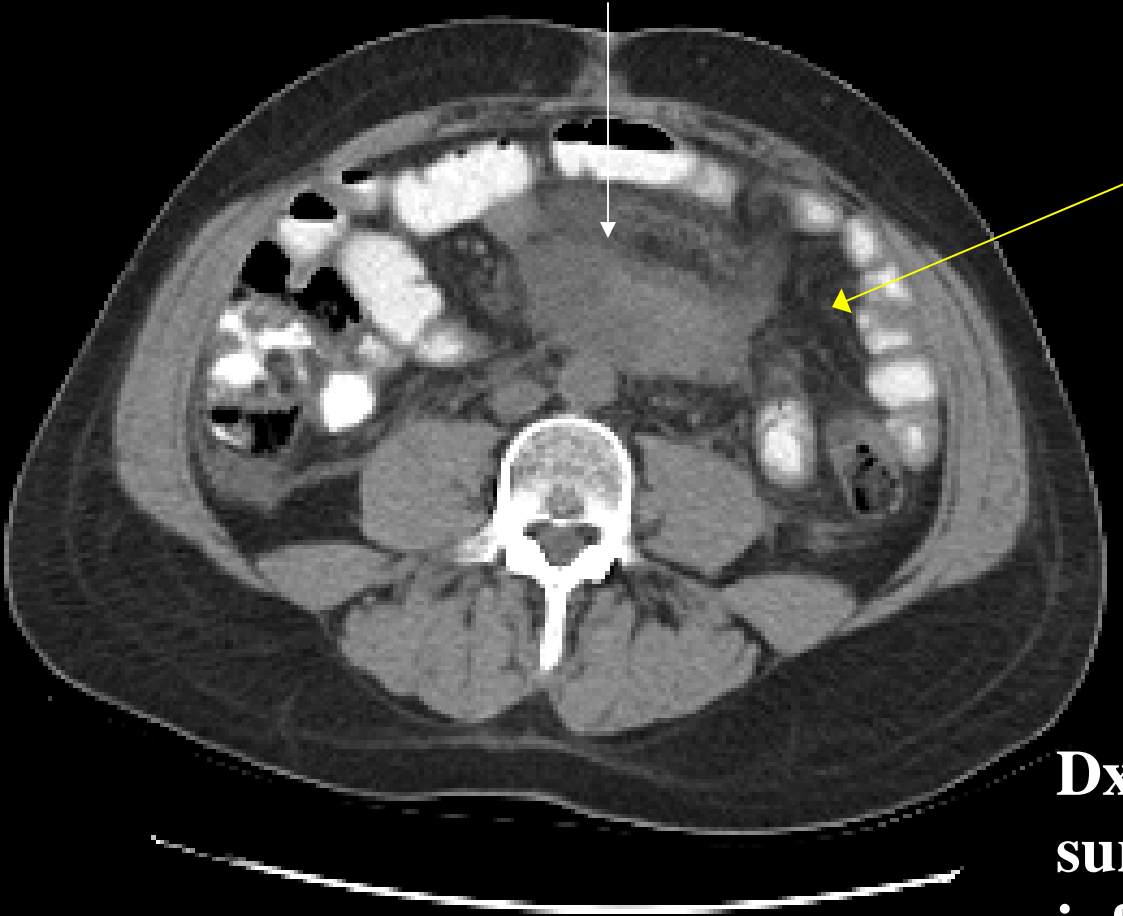
Sutures



Common Findings Post-Transplant

**Low attenuation
pancreatic transplant**

- dDx:**
- 1) Pancreatitis
 - 2) Vascular Occlusion
 - 3) Rejection



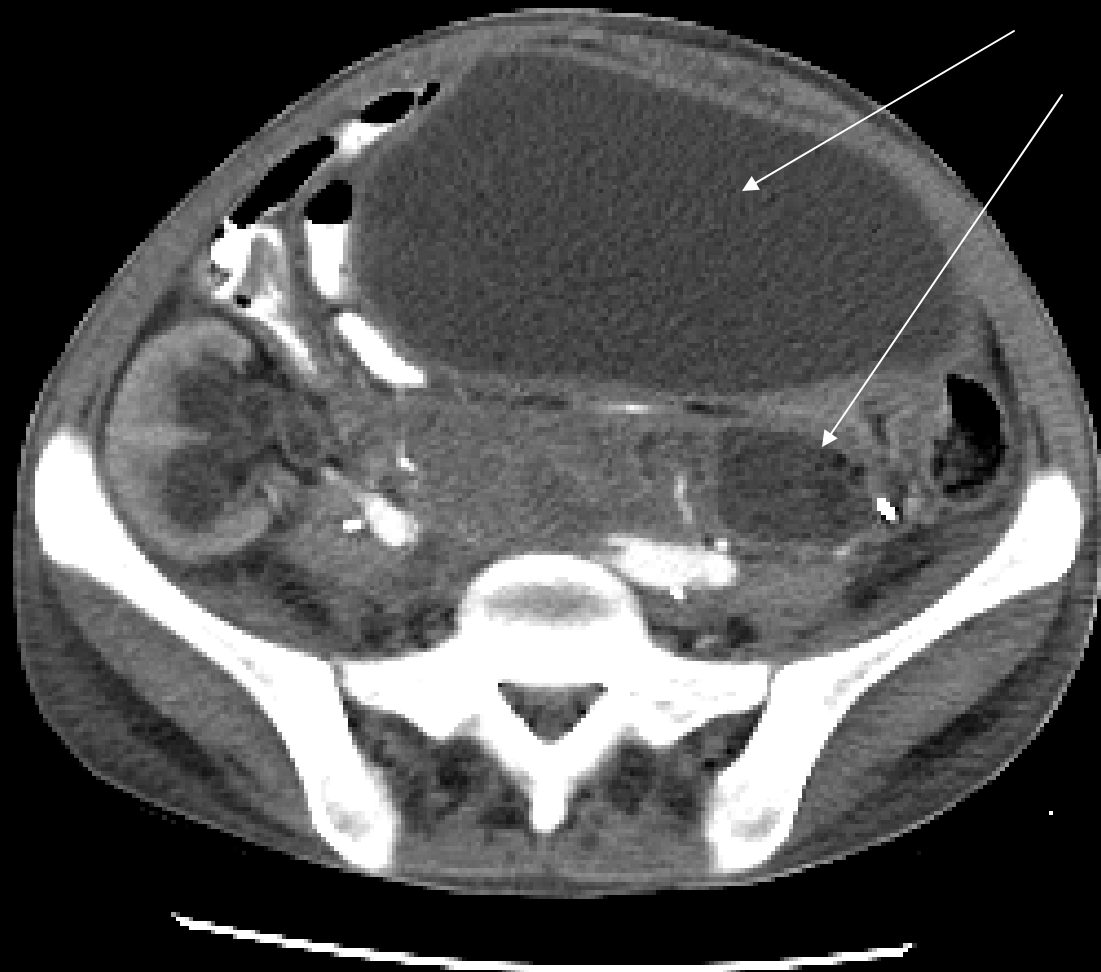
Peri-pancreatic fluid

- dDx:**
- 1) Edema
 - 2) Hematoma
 - 3) Ascites
 - 4) Pseudocyst
 - 5) Abscess
 - 6) Urinoma

**Dx: Pancreatic Rejection with
surrounding edema from
inflammation**



Abdominal Distension and ? Bowel Obstruction



**Multiple Large Loculated
Hypodense Regions with
HU of Fluid**

dDx: 1) Pseudocyst
2) Lymphocele
3) Seroma
4) Abscess

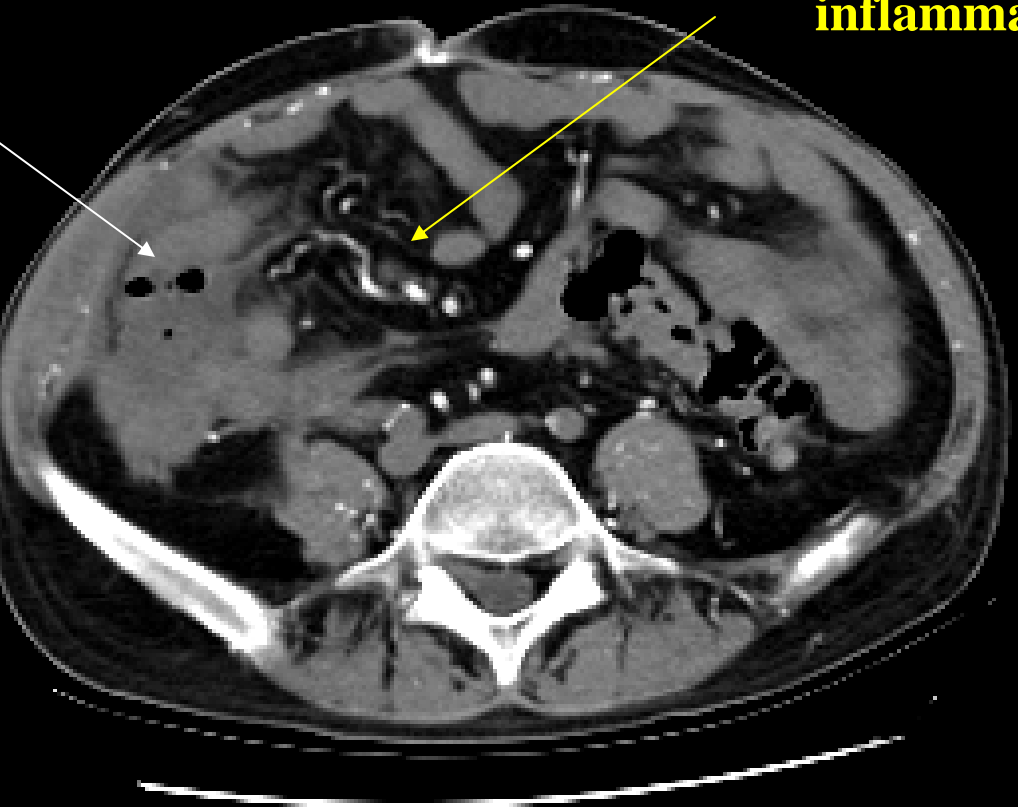
Dx: Pseudocyst



Fever and Abdominal Pain

**Fluid collection
with air**

**Stranding and fluid indicating
inflammatory changes**



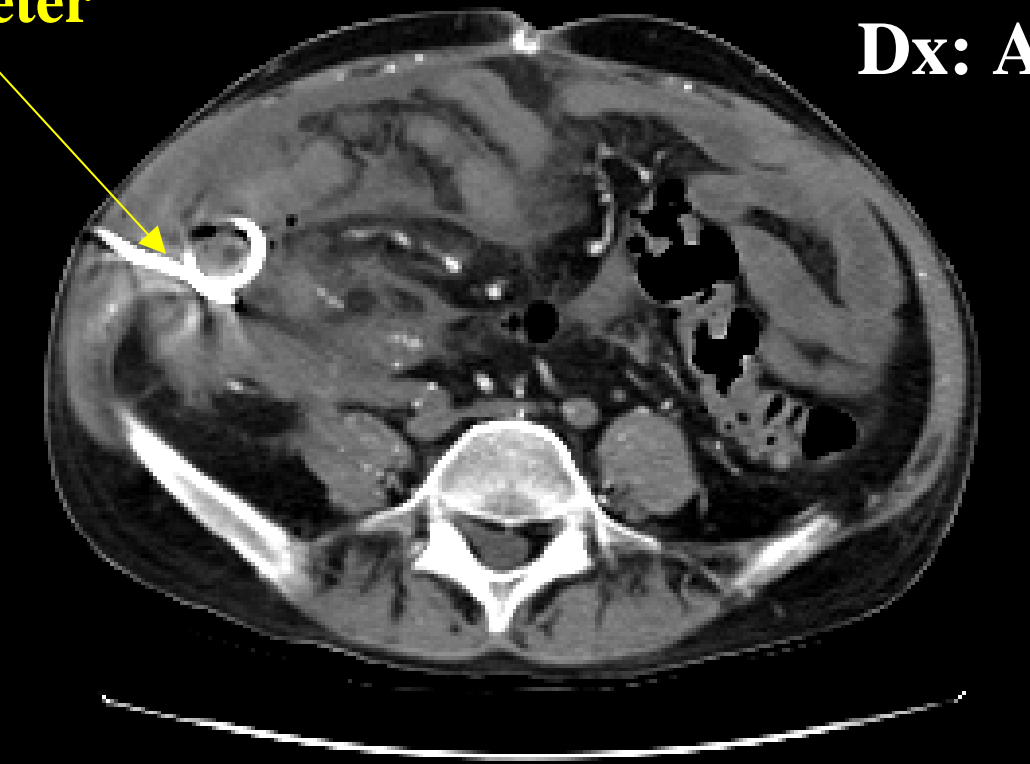
- dDx:**
- 1) Abscess**
 - 2) Pseudocyst**
 - 3) Cyst**



What can we do?

Drain the fluid with CT guidance!!

Pigtail Catheter

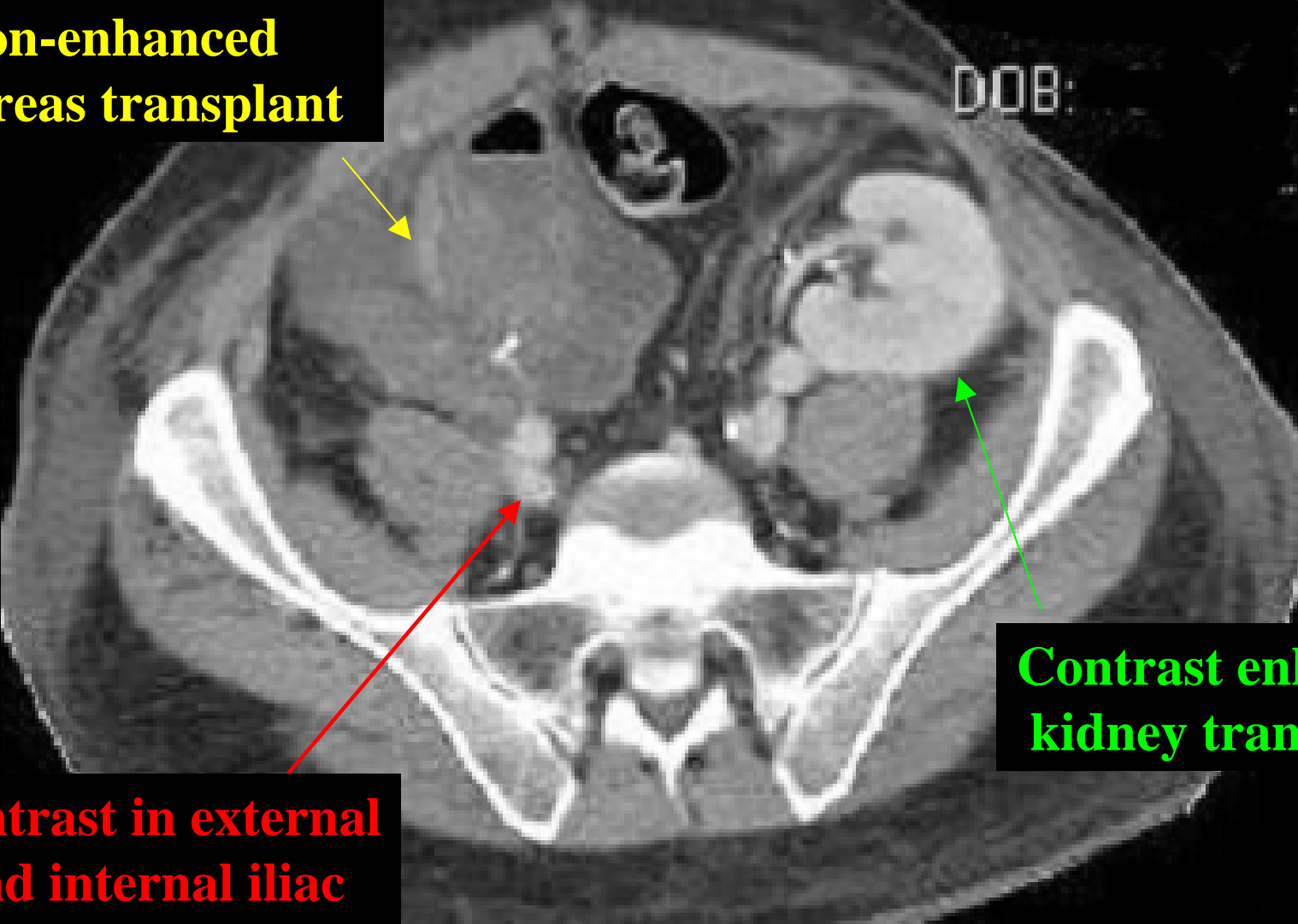


**Fluid was purulent
Dx: Abscess**



Demonstration of Pancreas Hypoperfusion on Arterial Phase of CT

**Non-enhanced
pancreas transplant**



**Contrast enhanced
kidney transplant**

**Contrast in external
and internal iliac
arteries**



Imaging technique: MRI

- Advantages

- Excellent visualization of soft tissue structures
- Effective alternative when difficult visualization by US or CT
- Contrast enhanced MRA and MRI useful in assessment of vasculature
 - Useful in pts who had a poor US study and cannot have CT IV contrast (renal compromise)
 - Study by Boeve WJ et al. indicates efficacy of modality when compared to intra-arterial digital subtraction angiography
- No radiation

- Disadvantages

- Still undefined role in pancreatic transplant evaluation
- Takes more time to image
- Some patients are contraindicated for imaging



Persistent Abdominal Pain and Inconclusive CT study

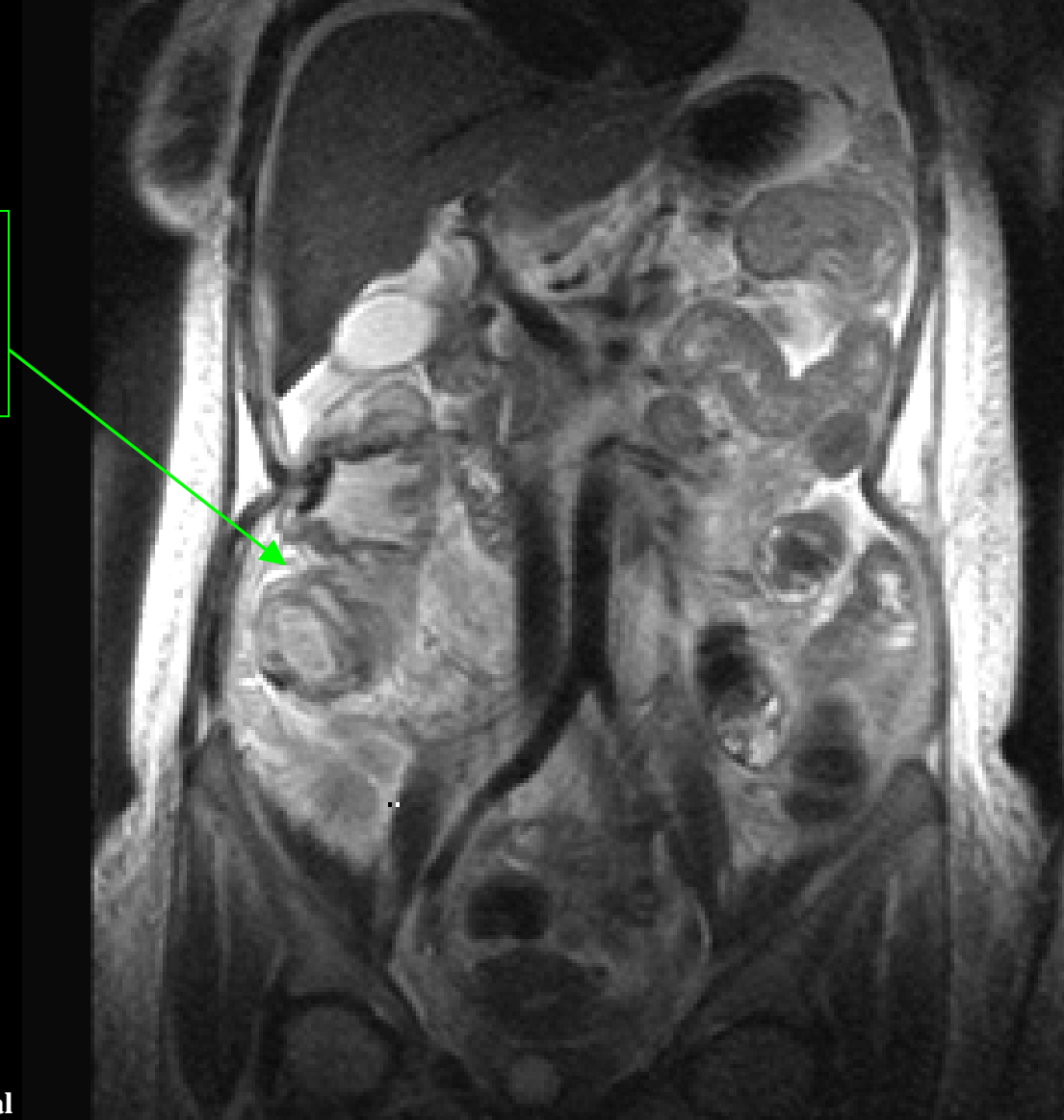
VIBE Sequence

Cecum

- 1) Thick Walls
- 2) Hypointense periphery

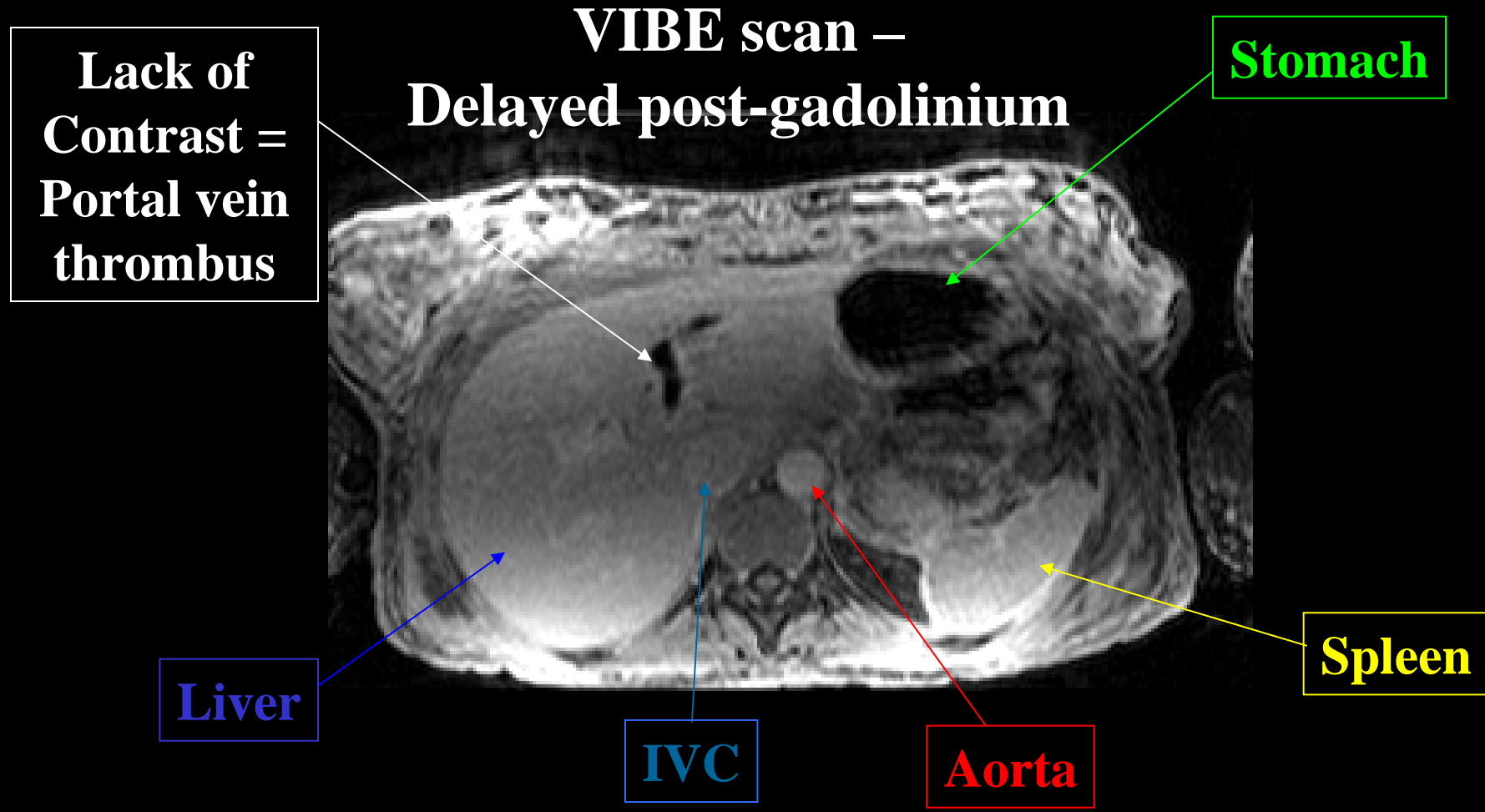
Suggestive of pneumatosis

NOT ALL POST-SURGICAL COMPLICATIONS INVOLVE THE PANCREAS





Persistent Abdominal Pain and Inconclusive CT study



Dx: Ascending Pyelophlebitis with Portal Vein Thrombosis



Diagnosis of Rejection

- Histopathologic by CT-guided or US-guided biopsy
- Chemical markers
 - SKP - \uparrow serum Cre (Kidney function serves as proxy)
 - PTA vesical drainage - \downarrow urinary amylase
 - PTA enteric drainage - ? \uparrow blood glucose levels
 - \uparrow serum amylase/lipase non-specific
- Imaging???
 - US: Resistive Index not proven to be effective
 - CT: No role
 - MRI: Dynamic contrast enhanced MRI: Krebs TL et al.



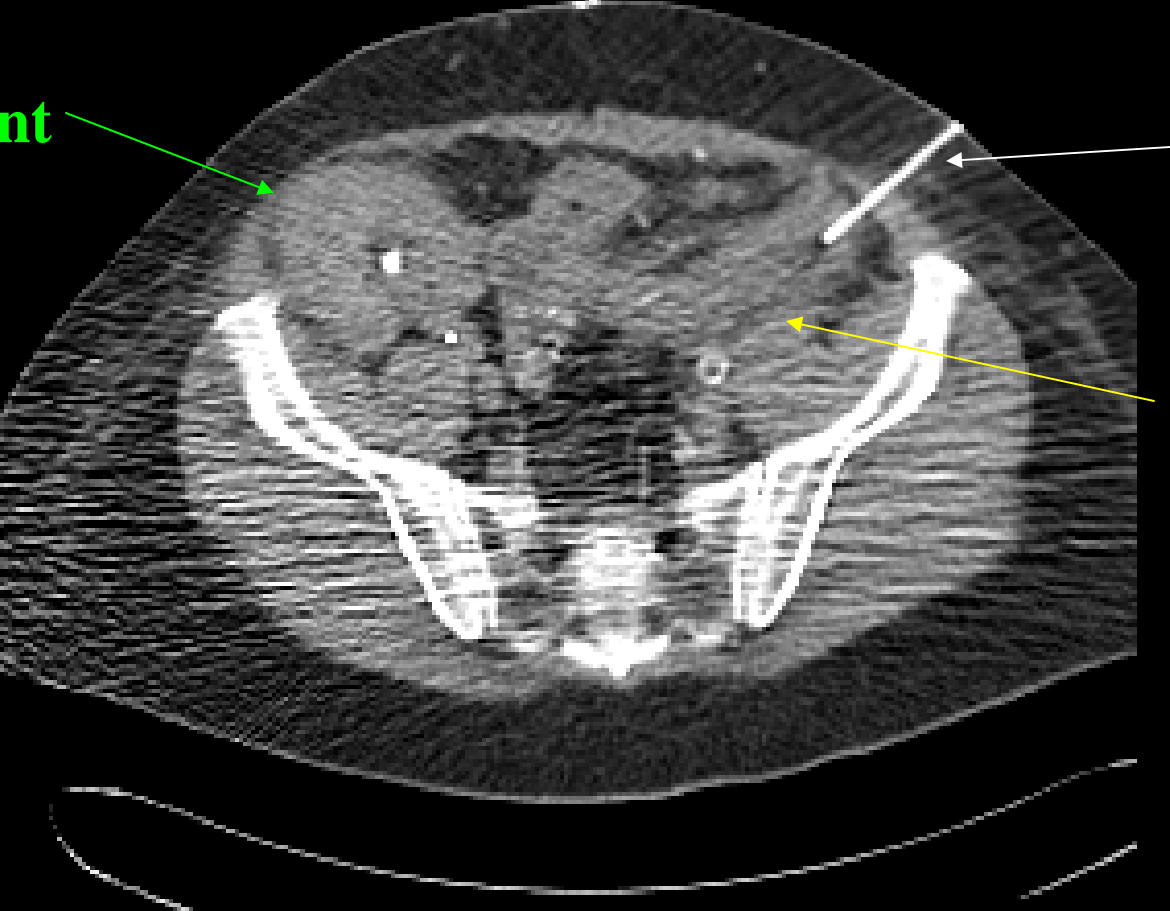
Percutaneous Biopsy

- Can be done with CT or US guidance
- Must consult and plan with transplant team
- 20g biopsy gun at more than one site
 - Possible differences in histology
 - Usually sample mid and proximal pancreas
- Post-biopsy complication of mild to moderate pancreatitis common



CT-guided Biopsy

**Kidney
Transplant**

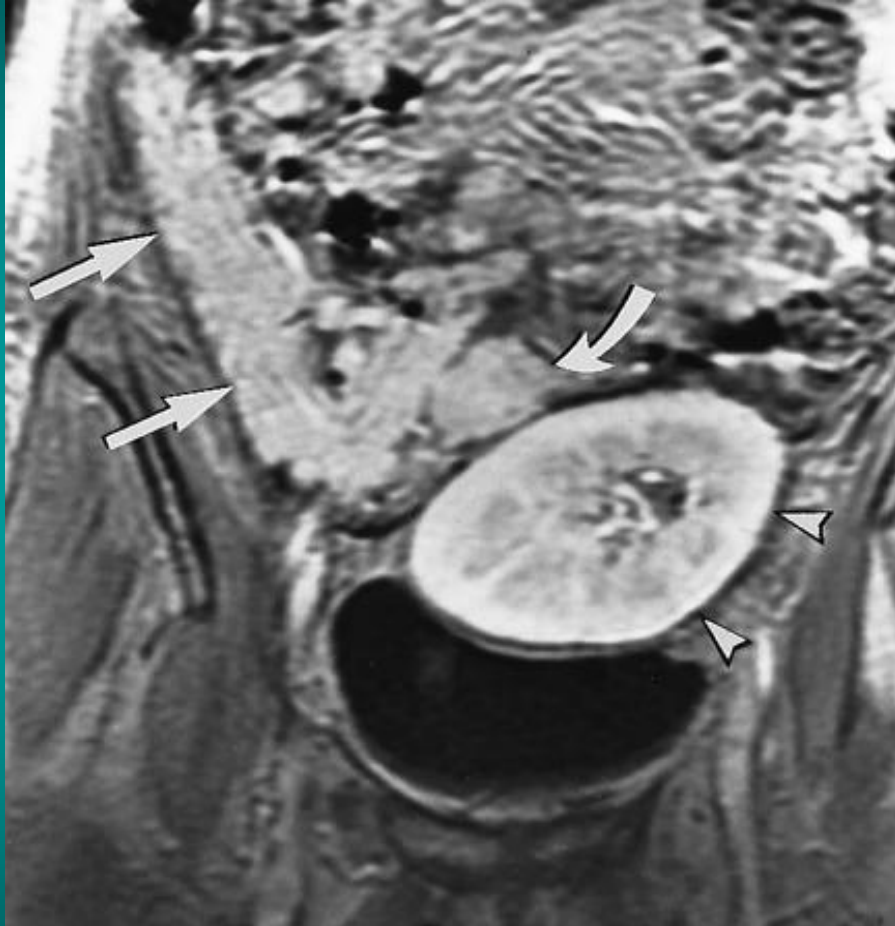


**Biopsy
Needle**

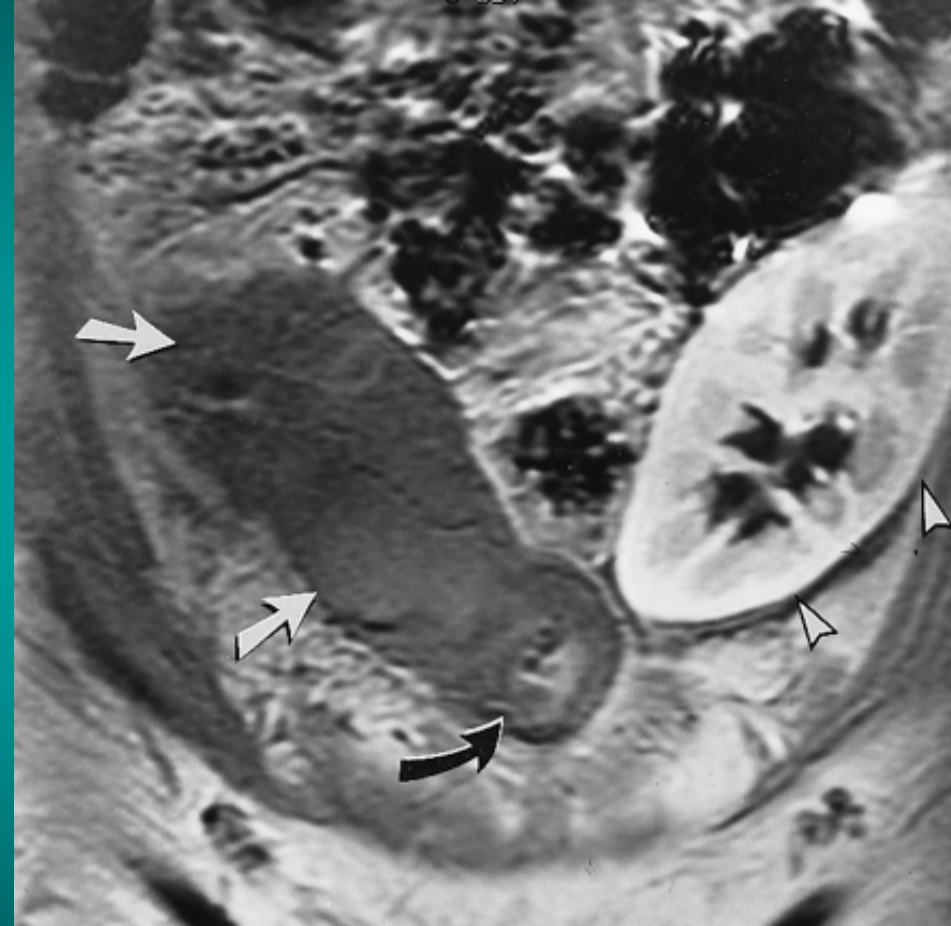
**Pancreas
Transplant**



Comparison of Gadolinium-enhanced GRE MR



Viable Pancreas



Rejected Pancreas

Arrowheads: Kidneys Arrows: Pancreas Curved Arrows: Duodenal Stump



Dynamic Contrast-enhanced MRI Evaluation of Acute Rejection

- Mean percentage of parenchymal enhancement (MPPE) determined at 1 minute post-gadolinium load
- MPPE corresponded to histopathologic analysis
- Demonstrates decreased MPPE with rejection compared to viable transplant



Summary

- **Immediate Perioperative Evaluation of Symptomatic Patient**
 - US: Confirm vascular competency (r/o thrombus)
 - CT:
 - Complications of severe pancreatitis
 - Anastomotic leak
 - Fluid collections
 - MR: Evaluate inconclusive US and/or CT study
- **Rejection Evaluation**
 - CT or US guided biopsy
 - ? Utility of MR



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